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LIX. — *On some Dipterous Larvæ infesting the Branchial Chambers of Land-crabs.* By D. KEILIN, Sc.D., Beit Memorial Research Fellow (from the Quick Laboratory, University of Cambridge).

To the great variety of conditions under which Dipterous larvæ of different kinds are found, Baylis (1915) * has added an interesting record by his discovery of a novel habitat, namely, within the branchial chambers of certain land-crabs.

The record is as follows :—

(1) Of three specimens of a land-crab—*Cardiosoma hirtipes*—from the Admiralty Islands ('Challenger' Collection), two were found to contain Dipterous larvæ within their branchial chambers.

(2) A fragment of a Dipterous larva was found adhering to the external surface of an example of the same species from Christmas Island, near to the lateral opening of the gill-chamber.

(3) Two small Dipterous larvæ were found in the branchial chamber of one of three specimens of a land-crab—*Gecarcoidea lalandii*—from Christmas Island (collected by Dr. R. Kirkpatrick).

* Baylis, H. A. (1915). "A parasitic Oligochæta and other Inhabitants of the Gill-chamber of Land-crabs," *Ann. & Mag. Nat. Hist.* ser. 8, vol. xv. pp. 378-383.

Mr. F. W. Edwards has suggested that the specimens probably belong to the subfamily Eristalinæ.

In his note Baylis expresses some doubt as to whether or not these larvæ can be actually parasitic; he believes it is possible that the larvæ may have been living in the decaying matter upon which the crabs feed, or that they frequent the water of streams into which the crabs may go, but, whether their presence in the branchial chambers of their hosts is accidental or not, "they would appear to have thriven there, and it is suggested as at least a possibility that they derived sustenance from the blood of the crabs, their chitinous 'jaws' enabling them to puncture the epithelium of the gills or of the vascular lining of the chamber" (p. 380).

Mr. F. W. Edwards has kindly invited me to examine these larvæ discovered by Baylis, in order that, by comparison with other Dipterous larvæ, their true systematic position might be determined, and an explanation found, if possible, for their presence in the gill-chambers of their hosts. The results of my investigation are embodied in this communication.

Mr. Edwards sent me two tubes of material, the contents of which, for convenience in the following descriptions, I shall designate by the letters A and B respectively. The first tube contained larvæ from the branchial chambers of *Cardiosoma hirtipes* (Admiralty Islands), while the second tube contained a single larva from *Gecarcoidea lalandii* (Christmas Island).

*Description of Larvæ A, from the Branchial Chambers
of Cardiosoma hirtipes.*

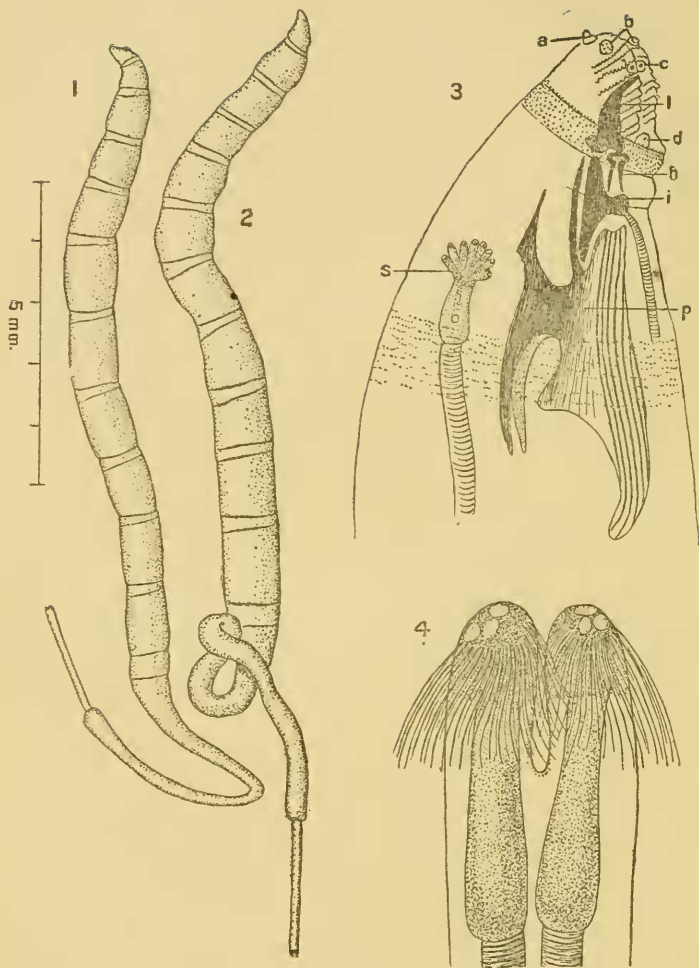
The tube contained two small and two large larvæ, all being already in the third stage of development. In each case the body is very elongate, and furnished posteriorly with a long respiratory siphon. The large larvæ (figs. 1 and 2), with completely evaginated siphons, attain a length of 19 to 22 mm., while their diameter at the widest part is only 0·7 to 1 mm. In common with other Cyclorhaphous Diptera, the body comprises a small head, three thoracic, and eight abdominal segments. The head, or *pseudocephalon*, resembles in structure that of all the larvæ of the Cyclorhapha (fig. 3); it is a small, soft, bilobed segment which can be retracted into the thorax, and is furnished with four pairs of sensory organs: (a) the bell-shaped *antennæ*; (b) *maxillary palps*, composed of several small papillæ; (c) *special sensory organs*, similar to those previously described by me

(1915, pp. 173-177*), and which are present in all Cyclorhaphous larvæ; and (*d*) *labial palps* in the form of small conical protrusions, each of which bears a single circular papilla. The ventral surface of the head-lobes is raised in several rows of rib-like projections, armed with strongly chitinised, bifid, reflexed hooks. Each of the three *thoracic segments* bears on its anterior part several sinuous rows of small hooklets and a definite number of sensory hairs and pits. The vestigial remains of the thoracic legs are represented by six groups, each consisting of three small sensory hairs. The prothoracic segment bears the pair of well-developed anterior spiracles. The first seven *abdominal segments* are twice as long as broad; they present a doubled appearance, owing to the conspicuous zone of articulation, where the segments are telescoped into each other. Each segment bears at its anterior border several sinuous rows of small reflexed hooklets. On the ventral surface of the eighth and last abdominal segment is the anus, which divides the segment into an anterior portion resembling that of the preceding abdominal segments and a posterior portion which is prolonged into the respiratory siphon. The proximal portion of the siphon resembles the corresponding portion of an ordinary abdominal segment; it becomes narrower posteriorly, forming an intermediate portion which is covered with small, forwardly-directed hooklets. The terminal portion of the siphon is slender, rigid, and tubular, and bears the pair of postabdominal spiracles at its extremity.

The respiratory system of this larva is amphipneustic; two pairs only of functional spiracles are present—the prothoracic and the postabdominal pairs. The *prothoracic spiracles* (fig. 3, *s*) comprise eight elongated papillæ which, by means of a well-developed felt-chamber, communicate with the two lateral tracheal trunks. The *postabdominal spiracles* (fig. 4) are situated at the extremity of the respiratory siphon, and, on account of the tip of the latter being bifurcated, are separated from one another by a fairly deep groove. Each spiracle appears to possess three spiracular clefts, surrounded by long divergent hairs. The felt-chamber, through which the spiracles communicate with the tracheal trunks, is very long and narrow.

The *bucco-pharyngeal organ* (fig. 3) shows the structure typical of all the Cyclorhaphous Diptera; it is comprised of

* Keilin, D. (1915). "Recherches sur les larves de Diptères Cyclorhaphes," Bull. Scient. de la France et Belgique, 7^e série, vol. xlix. pp. 15-192.

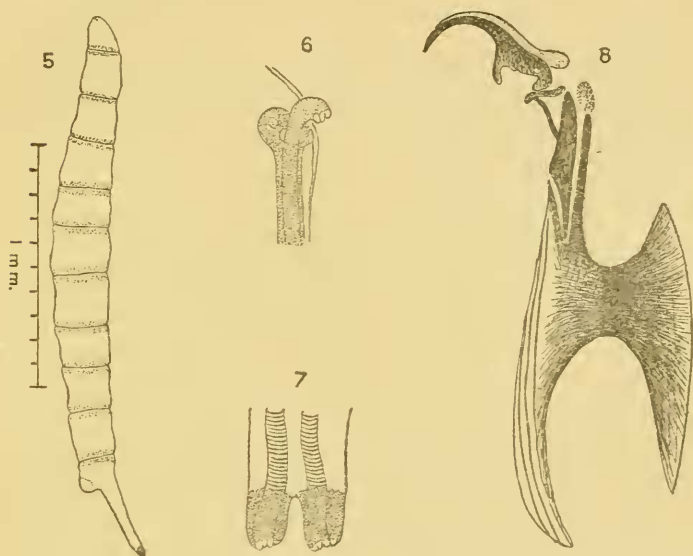


Larva A: Figs. 1 and 2.—Full-grown larvæ, seen laterally. Fig. 3.—Anterior portion of the larva, showing the thoracic segments, the head or the pseudocephalon, and the bucco-pharyngeal armature: *a*, antenna; *b*, maxillary palps; *c*, ventral sensory organ; *d*, labial palp; *h*, hypopharyngeal sclerite; *i*, intermediate sclerite; *l*, lateral hooks; *p*, basilar or pharyngeal sclerite; *s*, prothoracic spiracles. Fig. 4.—Posterior end of the siphon, showing the postabdominal spiracles. The scale represents only the magnification of the figs. 1 and 2.

three main portions:—(1) the *basal* or *pharyngeal sclerite* (*p*), the lateral parts of which are strongly chitinised, while the ventral part, which forms the floor of the pharynx, is thin, transparent, and thrown into longitudinal ridges which project into the pharyngeal lumen; (2) the *intermediate sclerite* (*i*), in the form of an **H**, its anterior space being occupied by a *hypopharyngeal sclerite* (*h*); (3) the *lateral hooks* (*l*), which are well developed and each provided with a single tooth only.

Description of Larva B, from the Branchial Chamber of Gecarcoidea lalandii.

The single specimen of this larva which I have been able to examine is in the second stage. It measures 2·3 mm. by



Larva B: Fig. 5.—The larva seen laterally. Fig. 6.—Prothoracic spiracle during the moulting. Fig. 7.—Postabdominal spiracles. Fig. 8.—Bucco-pharyngeal armature. The scale represents only the magnification of fig. 5.

0·25 mm. Its body also is comprised of a small *pseudo-cephalon*, three *thoracic*, and eight *abdominal* segments (fig. 5). The anterior and posterior margins of each segment bear several sinuous rows of small hooklets. The last

abdominal segment is prolonged beyond the anus so as to form a respiratory siphon similar to, but much shorter than, that of larvæ A. The larva is amphipneustic; the prothoracic spiracles (fig. 5) protrude slightly externally and show traces of the spiracular papillæ, whose number I could not determine. As in Larvæ A, the respiratory siphon is bifurcated at its extremity, and, in consequence, the post-abdominal spiracles are separated by the groove of the bifurcation (fig. 7). The *bucco-pharyngeal armature* of this specimen resembles that of Larvæ A, but the sclerites are relatively more slender (fig. 8).

The Systematic Position of Larvæ A and B.

As already mentioned, these larvæ had been associated by Mr. F. W. Edwards with the Eristalinæ (Syrphidæ). He supplied, moreover, the following information (see Baylis, p. 379):—"Dipterous larvæ from *Cardiosoma hirtipes*.—These larvæ are evidently Syrphidæ, and apparently belong to the subfamily Eristalinæ; they differ from *Eristalis* in the more elongate form and the lack of any obvious separation into 'body' and 'tail.'

"Larvæ from *Gecarcoidea lalandii*.—These are also Syrphidæ, but in the present state of our knowledge it is impossible to assign them definitely to any subfamily. They appear to lack the extensile 'tail' of *Eristalis*."

The foregoing remarks show that Edwards was guided in his identifications solely by the general conformation of the body, and especially by the presence of a well-developed postabdominal respiratory siphon. As a matter of fact, the resemblance between larvæ A and an Eristaline larva is most remarkable. It must be remembered, however, that the possession of a postabdominal siphon is merely evidence of the fact that the larva inhabits a fluid or semi-fluid medium, and the greatest caution must be exercised before making use of it as a character for the purpose of systematic classification. A well-developed postabdominal respiratory siphon is known to exist in many totally different groups of Dipterous larvæ, *e.g.*, Ptychopteridæ, Psychodidæ, Culicidæ, Stratiomyidæ, Phoridæ, Eristalinæ (Syrphidæ), Anthomyidæ, Ephydridæ, Drosophilidæ, and others.

Being specially interested in the structure of Eristaline larvæ, I have had occasion to examine many examples of this subfamily, and, from my knowledge of their morphology, I am forced to the conclusion that the larvæ under consideration have no affinity whatever with the Eristalinæ,

nor indeed with the Diptera Aschiza in general. For the purpose of comparison, I tabulate below some of the more important differences between Eristaline larvæ and these examples from the gill-chambers of crabs:—

<i>Eristaline larvæ.</i>	<i>Larvæ A and B.</i>
(1) Siphon not bifurcated, posterior spiracles adjacent.	(1) Siphon bifurcated, posterior spiracles separated.
(2) Prothoracic spiracles of small size.	(2) Prothoracic spiracles well developed in larvæ A, larva B is in the second stage only.
(3) Antenna and maxillary palp united to form a single sensory organ.	(3) Antennæ and maxillary palp distinctly separated.
(4) Bucco-pharyngeal apparatus exhibiting a special structure, quite different from the type usually found in Diptera Cyclorhapha.	(4) Bucco-pharyngeal apparatus of the ordinary type common to all Cyclorhapha Schizophora.

All this shows that the resemblance between the larvæ A and B and the Syrphid larva is only a superficial one—it is nothing more than a case of convergence.

The question now arises: What is the correct systematic position of these larvæ?

In the existing state of our knowledge of the larvæ of Cyclorhaphous Diptera, it is always difficult, and often impossible, to determine even the family to which a particular example belongs. Nevertheless, the structure of the head, mouth-parts, and spiracles indicate, first of all, that the larvæ A and B belong to the Diptera Cyclorhapha Schizophora. They appear to show a close affinity with the family Ephydridæ—this for the following reasons:—

(1) Larvæ of the Ephydridæ, like larvæ A and B, are always provided with postabdominal respiratory siphons.

(2) In this family the siphon is always bifurcated as in larvæ A and B.

(3) The prothoracic spiracles are well developed in the Saprophagous Ephydrid larvæ, similar to those of larva A.

(4) The mouth-parts of larvæ A and B are of the Ephydrid type.

(5) The ventral surface of the head in Ephydrid larvæ, as in larva A, is furnished with plates and dentate scales.

(6) Several species of Ephydrid larvæ are known to occur in salt or brackish water.

It is, therefore, highly probable that the larvæ A and B, discovered by Baylis, belong to the family Ephydridæ, or, at least, are very closely allied to that family.

As to whether or not these larvæ are parasitic in their habitat is a matter of some doubt. It is probable that they live in salt or brackish water, and that their presence in the branchial chambers of crabs is purely accidental. The structure of their bucco-pharyngeal organs, and especially their possession of well-developed longitudinal pharyngeal ridges, show that they are, to some extent at least, saprophagous (*see* Keilin, 1915, *l. c.* pp. 127-132). They probably feed on the detritus of variable nature, which they find in the branchial chamber of crabs, but it cannot be denied that they may also obtain food, in the form of blood or mucus, from the gills of the crab, by inflicting wounds with their well-developed lateral hooks and the dentate process on the ventral surface of the head.

LX.—*On a further Collection of Mammals from Jujuy obtained by Sr. E. Budin.* By OLDFIELD THOMAS.

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DURING April, May, and June of this year Sr. E. Budin returned to the region where his first collection had been made in 1913, as he knew of a number of species which he had not succeeded in obtaining, and of which he wished to procure examples.

In this respect he was exceedingly successful, as the present collection, consisting of one hundred and seventeen specimens, included examples of no less than five new species, besides nice sets of various other forms which had been previously obtained by him in this and neighbouring provinces.

How much Sr. Budin has contributed to our knowledge of the mammalogy of this region is shown by the fact that of twenty-two species in the present collection no less than fifteen have been now or previously discovered by him, while of the thirty others from Jujuy sent in earlier collections he was the discoverer of eighteen, so that he is the first captor of no less than thirty-three of the known mammals of Jujuy.

Of the collection now dealt with the most interesting are the squirrel, never obtained before in the Argentine*, and the *Neotomys*, a swamp-rat congeneric with a Peruvian species, and a very striking addition to the fauna of Jujuy.

* Though recorded, on the evidence of natives and of gnawed nutshells, by Matschie, SB. Ges. Nat. Fr. 1894, p. 61.